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The Alpine zero-degree line in a changing climate

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A range of recent studies and national climate scenario initiatives have shown that 21st Century global climate change will also strongly affect the climate of the European Alps. Among others, a continued near-surface warming larger than the global mean warming is projected, with the average warming rate depending on the emission scenario considered and being subject to model and internal variability uncertainty. The projected warming pattern is furthermore subject to some horizontal variability and also shows elevation dependencies. These factors will influence the future evolution of the regional zero-degree line elevation in the European Alps. This elevation often serves as an illustrative but also quantitative proxy for climate change impacts on different sectors, such as the terrestrial cryosphere or ecosystem services.

In the present contribution we assess the future evolution of the Alpine zero-degree line under different emission scenarios and for a large ensemble of underlying regional climate model (RCM) simulations. The latter originate from the regional climate projection ensemble of the EURO-CORDEX initiative. The temporal evolution of the zero-degree line is analyzed in the raw climate model output and, focusing on the region of Switzerland, in bias-corrected scenario products. Overall, we find a consistent rise of the zero-degree line elevation subject to some seasonal and regional variation. In Switzerland, for instance, the mean winter zero-degree line is projected to rise from today's $\sim$800m to $\sim$1700m by the end of the Century and for the strong emission scenario RCP8.5. The rise per degree Celsius of warming approximately corresponds to standard atmospheric lapse rates in today's climate.